1) Find a vector $\vec{M}$ whose magnitude is 9 and whose direction is perpendicular to both vectors $\vec{E}$ and $\vec{F}$, where $\vec{E} = \hat{a}_x + 2\hat{a}_y - 2\hat{a}_z$ and $\vec{F} = 3\hat{a}_y - 6\hat{a}_z$

2) Determine if each of the following vector fields is solenoidal, conservative, or both:

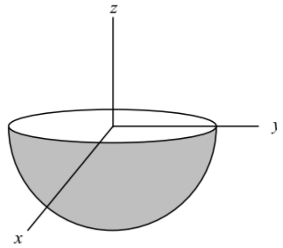
(a) $\vec{A} = \mathrm{x}^2\hat{a}_x - 2\mathrm{xy}\hat{a}_y$

(b) $\vec{B} = \mathrm{x}^2\hat{a}_x - \mathrm{y}^2\hat{a}_y + 2\hat{a}_z$

(c) $\vec{C} = \frac{sin(\varphi)}{\rho^2}\hat{a}_\rho + \frac{cos(\varphi)}{\rho^2}\hat{a}_\varphi$

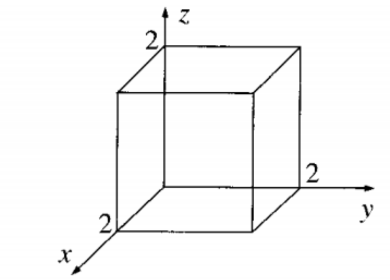
(d) $\vec{D} = \mathrm{r}e^{-r}\hat{a}_r$

3) Test the divergence theorem for the vector: $\vec{A} = rcos(\theta)\hat{a}_r + rsin(\theta)\hat{a}_\theta + rsin(\theta)cos(\varphi)\hat{a}_\varphi$ over the volume of hemisphere of radius R.

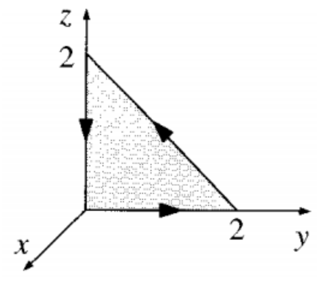


4) Test the divergence theorem for the displacement vector $\vec{r}$ over the volume of a cylinder of radius *R* and height *H.* The bottom base of the cylinder lies on the *x-y* plane.

5) Test the divergence theorem for the vector field $\vec{A} = xy\hat{a}_x + 2yz\hat{a}_y + 3xz\hat{a}_z$. Take the cube as your volume shown in Figure, with sides of length 2.

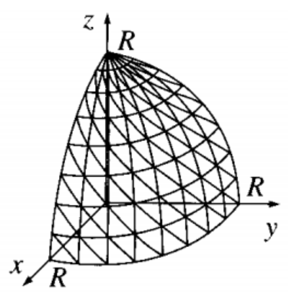


6) Test Stokes' theorem for the function $\vec{A} = xy\hat{a}_x + 2yz\hat{a}_y + 3xz\hat{a}_z$, using the triangular shaded area of Figure.

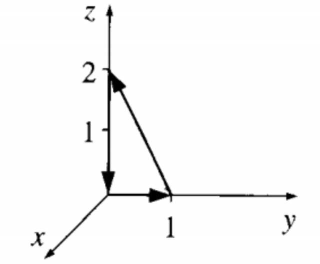


7) Check the divergence theorem for the vector field

$\vec{F} = r^2cos(\theta)\hat{a}_r + r^2cos(\varphi)\hat{a}_\theta - r^2cos(\theta)sin(\varphi)\hat{a}_\varphi$ using the volume one octant of the sphere of radius *R* (Shown in figure).



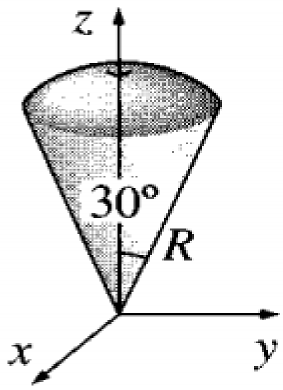
8) Compute the line integral of $\vec{A} = 6\hat{a}_x + yz^2\hat{a}_y + (3y + z)\hat{a}_z$. along the triangular path shown in Figure. Check your answer using Stokes' theorem.



9) Check the. divergence theorem for the vector field

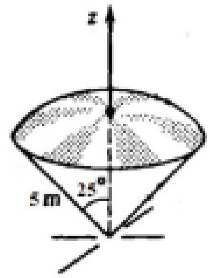
$$\vec{F} = r^2 sin(\theta)\hat{a}_r + 4r^2 cos(\theta)\hat{a}_\theta - r^2 tan(\theta)\hat{a}_\varphi$$

using the volume of the. " ice-cream cone" shown in Figure (the top surface is spherical, with radius R and centered at the origin).



10) A vector field is given by $\vec{G} = 15\,\hat{a}_r$ .Verify Stoke's theorem for a segment of a spherical surface defined by :

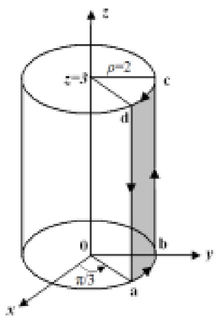
$$r = 5m, 0 \le \theta \le 25°, 0 \le \varphi \le 2\pi$$



11) If $\vec{D} = 2r\,\hat{a}_r\ \mathrm{C}/m^2$, find the total electric flux leaving the surface of cube $0 \le x, y, z \le 0.4$

12) Verify Stoke's theorem for a vector field $\vec{G} = \frac{\cos(\varphi)}{\rho}\ \hat{a}_z$ in the segment of cylindrical surface defined by

$$\rho = 2, \frac{\pi}{3} \le \varphi \le \frac{\pi}{2}, 0 \le z \le 2$$



13) Find the Cartesian components of the electric field due to finite line charge $\rho_l = 15\mu C/m$ along the x axis from x 2 to 4 m at point (0,3,0) m.

14) Determine $\vec{E}$ at (x,-1,0)m due to a uniform sheet charge with $\rho_s = \frac{1}{3\pi} nC/m^2$ is located at z= 5m and a uniform line charge with $\rho_l = \frac{-25}{9} nC/m$, at z=-3,y=3m.

15) The following charge distributions are present in free space:

A 12nC point charge at P(2,0,6), a uniform line charge density 3nC/m at x=-2,y=3 and an infinite uniform surface charge density 0.2 nC/m^2 at x=2.

[1] Find $\vec{E}$ at the origin.
[2] Determine the force acting on a point charge 10 μC placed at the origin.
[3] Calculate the total electric flux leaving the surface of a sphere of 2 m radius centred at (2,0,6).

16) If $V = \frac{sin(\theta)}{r^2}\ V, Find\ \vec{E}\ and\ \rho_v.$

17) If $\vec{D} = \frac{5}{r^2}\ \hat{a}_r - r^2\varphi sin(\theta)\hat{a}_\varphi\ \mathrm{C}/m^2$ for a sphere or radius a . What is ρ_v in the sphere?

18) The Line x=3, z= –1 carries charge 20 nC/m while plane x= –2 carries charge ρ_0 nC/m^2. If the force acts on a point charge -5 mC located at the origin is: $\vec{F} = -0.6\hat{a}_x - 0.18\hat{a}_z$ N. Find the value of the surface charge density ρ_0.